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ABSTRACT

The prior knowledge that a student brings into the lecture is one of the major factors influencing teaching effectiveness. It is therefore important that lecturers are able to ascertain the level of prior knowledge and adjust their teaching accordingly. This paper adopts an iterative learning model that seeks to enhance teaching effectiveness by developing and leveraging prior knowledge and illustrates this approach in the context of information systems technology (IST) teaching. The paper introduces, in the context of a case study, a four-stage (Enrich, Evaluate, Reflect, Activate) iterative learning model that incorporates the process of enrichment, evaluation and activation of prior knowledge on a particular subject or learning unit. This model has been formulated on the basis of a review of literature on prior know ledge and adopted in the context of IST teaching. Includes one figure: the iterative learning model. (Contains 10 references.) (Author/AEF)

IMPROVING TEACHING EFFECTIVENESS UNDERSTANDING AND LEVERAGING PRIOR KNOWLEDGE FOR STUDENT LEARNING

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ABSTRACT

The prior knowledge that a student brings into the lecture is one of the major factors influencing teaching effectiveness. It is therefore important that lecturers are able to ascertain the level of prior knowledge and adjust their teaching accordingly. This paper adopts an iterative learning model that seeks to enhance teaching effectiveness by developing and leveraging prior knowledge and illustrates this approach in the context of IST teaching.

> The most important single factor influencing learning is what the learner already knows. Ascertain this and teach accordingly (Ausubel et al., 1978: 163).

INTRODUCTION

The aim of teaching quite simply is "to make learning possible" (Ramsden, 1992). While much of university education is based on the theory that students will learn if information is transmitted during lectures or if they do things in practicals or seminars, teaching as making learning possible represents a speculative and reflexive activity. This approach to teaching views the students, teaching and the subject to be learned as interactive components of an integrated model. From this perspective, teaching is an iterative process of continuous improvement based on the interactions between the framework components.

One of the main attributes of the student component that influences the learning process is their prior knowledge of material relevant to the subject. A number of research studies indicate that the variance in students' prior knowledge is one of the strongest factors influencing their educational achievement and their understanding of the lecture material (e.g. Beckwith, 1991; Hadwin et al, 1999; Yates & Chandler, 1991). Laurillard (1993) further argues that "it is impossible for teaching to succeed if it does not address the current forms of

student understanding of a subject". Prior knowledge can have positive and/or negative effects on learning. Pre-existing knowledge has a cumulative impact on individual development thereby accelerating the learning process. However, existing knowledge can inhibit learning if it contains misconceptions (i.e. faulty beliefs or knowledge based on misinformation). In recognition of this twofold impact of prior knowledge, the learning process should be directed so that it 1) builds on positive and consistent prior knowledge and 2) eliminates or reduces the impact of misconceptions.

One of the difficulties in applying a learning strategy targeted at the level of students' prior knowledge is the lack of information regarding these levels. Normally, lecturers receive feedback on students knowledge and understanding through formal assessment at the end of a teaching block. While such post-teaching assessments provide useful indicators of student performance they have a limited capacity for corrective effect on the teaching process. Ausubel at al (1978) emphasises the importance of checking on the prior knowledge – what students bring into a course – and using this to inform teaching. Where the lecturer is unable to accurately ascertain the level of prior knowledge relevant to course content, it becomes difficult for students to successfully participate in exercises that require the application of prior knowledge. Furthermore, since lecturers will often address groups with different levels of prior knowledge this can cause problems in determining the level at which teaching should be targeted (Entwistle, 1998). In an effort to ensure that students have a common understanding of concepts, the lecturer may then find him/herself having to spend valuable lecture time conveying large amounts of information, rather than focusing on higher level goals of analysis and synthesis (Jenkins, 1994). It is therefore important to not only determine existing knowledge but to also ensure that there is an existing level of shared awareness of required concepts.

Finally, Yates and Chandler (1991) argue that possessing knowledge is not equivalent to using this knowledge for achieving cognitive, learning or mnemonic goals. As knowledge is inert, failure to activate prior knowledge in a problem solving environment obstructs the learning process. Willoughby et al. (1993) employ an interrogation technique to activate existing prior knowledge and boost learning. Christen and Murphy (1991) argue that challenging the students to call on their prior knowledge transcends the learning process from memorisation to meaningful learning.

Ramsden (1992) suggests that excellence in teaching requires constant attention to how a subject is being understood by students, and the ability to use the assessment to change instruction so that it more accurately addresses student's errors and misconceptions. This paper is therefore premised upon the need to more accurately understand what students know about a subject (prior knowledge), to enrich their prior knowledge and to use this understanding to inform teaching. The remainder of this paper introduces, in the context of a case study, an iterative learning model that incorporates this process of enrichment, evaluation and activation of prior knowledge on a particular subject or learning unit. This model has been formulated on the basis of a review of literature on prior knowledge and adopted in the context of IST teaching.

THE CASE STUDY

Information Systems and Technology is a year-long undergraduate Level-100 course with a current enrollment of 447 students. There are no pre-requisites (or restrictions) for entry into this course. The student population consists of a cross-section of students: intending majors in Computer Science (CS) or Information Systems (IS); and other-majors (eg. accounting) who want to be IS-literate but not IS-professionals. Some students will take this course having taken or concurrently taking Level-100 courses in CS. Others may be Level-200 of Level-300 IS or CS-majors needing the course to complete the credit requirements for their degree. These characteristics lead to significant differences in the prior knowledge of the student population.

The course aims to develop, in students, an understanding of Information Systems and Technology and its applications to modern business needs including the application of information systems models to the analysis of business situations.[1] A large portion of the lectures are dedicated to the application of knowledge using active participation techniques. It is the experience of the lecturers in this course that the success of active participation within a large class setting is impacted by the aggregate level of content knowledge in the particular subject area. If the aggregate level of content knowledge can be ascertained, then the lecturer is able to balance materials delivery and applied learning. In addition, the level and content of the applied examples can be targeted at the appropriate level.

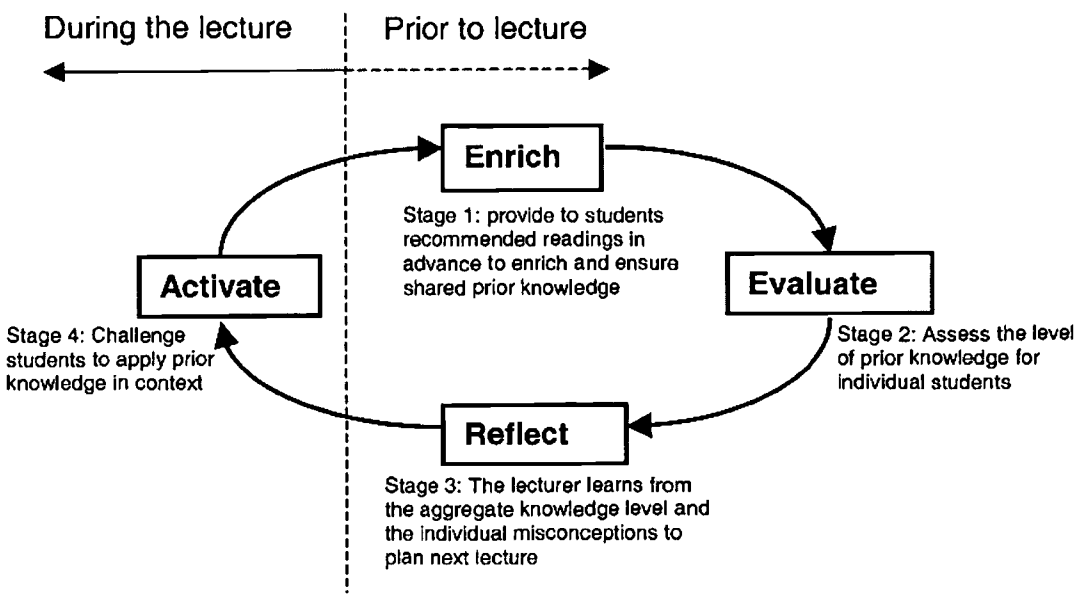
To evaluate prior knowledge, students are required to participate in weekly on-line tests. These tests are accessed via the WWW and are normally available for a week prior to the respective lecture. Students are given 10 minutes in which to complete five (5) randomly selected multi-choice questions. Submissions are marked on-line and feedback is immediate. Students are awarded ½% point for each test; the final mark is based on the best 10 submissions (maximum of 5% in total). Since the final mark is determined using the best 10 of the test sittings, students are thereby encouraged to participate without fear of failure. Approximately 60% of the students complete the weekly on-line tests. Prior to the lecture session, the summarised test results are reviewed by the lecturer to distinguish those topics on which students performed well or poorly. The distribution of incorrect responses for each question is also reviewed. The following section discusses, in the context of the above case description, the adoption of a four-stage iterative learning model that seeks to determine (*enrich*), *evaluate*, and leverage (*reflect* and *activate*) prior knowledge.

THE ITERATIVE LEARNING MODEL

To improve the effectiveness of the teaching process, a four stage evolutionary model of learning is proposed that builds on and utilises students' prior knowledge of relevant material (Figure 1). The model supports the concepts of determination and activation of prior knowledge. In the first two stages of the model, prior knowledge is built and assessed. The third and fourth stages demonstrate how teaching can be adjusted to leverage and activate prior knowledge.

In the first stage (*Enrich*) students are provided with recommended readings for the forthcoming lecture. This encourages students to develop a common knowledge base prior to the lecture. The readings normally consist of both theoretical definitions and facts (declarative knowledge) and problem scenarios (applied knowledge).

FIGURE 1
THE ITERATIVE LEARNING MODEL



To encourage preparation for lectures and to help determine their understanding of such material, in the second stage (*Evaluate*) students are required to take a weekly on-line (WebCT-based) test. While the technique of on-line testing is not new, these tests focus not on an assessment of students' understanding of *taught* material, but on determining the students' prior understanding of forthcoming material and using this to inform teaching. An analysis of the responses contribute to a better understanding of students' prior knowledge, and their errors and misconceptions. The process of *evaluation* also provides an incentive (by way of credit) that encourages students to prepare for lectures *(enrichment)* and participate in on-line testing.

In the third stage (*Reflect*), the lecturer's understanding of students' prior knowledge is used to inform teaching practice in the lecture sessions (Ausubel et al, 1978). While assessment often provides feedback to students on how they should learn (or have failed to learn), this form of assessment is designed to provide feedback to teachers on how to teach. The lecturer is able to tailor the session to appropriately balance content delivery, clarification of misconceptions, and analysis and application of concepts. In the context of the case study, the summarised results from the on-line tests are reviewed and appropriate annotations and emphases are made to the prepared lecture. The lecturer is then able to place additional emphasis on the material that students did not grasp as well as correct misconceptions in prior knowledge.

The final stage (*Activate*) of the Iterative Learning Model involves the activation of prior knowledge. During the lecture, students are challenged to recall prior knowledge as they apply it to problem-solving scenarios and link new concepts to pre-existing ones. Activation of knowledge allows the students to appreciate "how and when existing mental elements can bear upon new demands" (Yates and Chandler, 1991). The declarative knowledge accumulated through prior reading is transformed into procedural knowledge that is bound by context (e.g. through case-based scenarios). This further enriches student knowledge in the subject area and creates a progressive accumulation of knowledge. Hence, learning becomes an iterative process.

CONCLUSION

The knowledge that students bring to the lecture is one of the most important factors influencing their learning. Since effective teaching is that which makes learning possible it is of great importance that lecturers understand the level of the students' prior knowledge and target their teaching accordingly. This paper has proposed an iterative learning model that aims to improve teaching effectiveness by building and leveraging the prior knowledge of the learner. The model has been adopted in the context of teaching and learning in IS education. Based on the iterative learning model, this paper describes a technique (through on-line testing) that can help determine and leverage the prior knowledge of students, for informing teaching. Future research could undertake an analysis of the impact of this approach on teaching effectiveness as measured by student understanding, motivation and performance.[2]

END NOTES

1. Source: Department of Accountancy, Finance and Information Systems: Undergraduate & Graduate Courses 2000, University of Canterbury, NZ, p. 12.

2. It is expected that preliminary results of the impact of on-line testing on teaching effectiveness and student learning will be available at the end of the 2000 academic year.

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